a

10-Bit, 100 MSPS A/D Converter

PRELIMINARY DATASHEET 5/29/97 AD9071

The AD9071 is a monolithic sampling analog–to–digital converter with an on–chip track–and–hold circuit and TTL digital interfaces. The product operates at a 100 Msps conversion rate with outstanding dynamic performance over its full operating range.

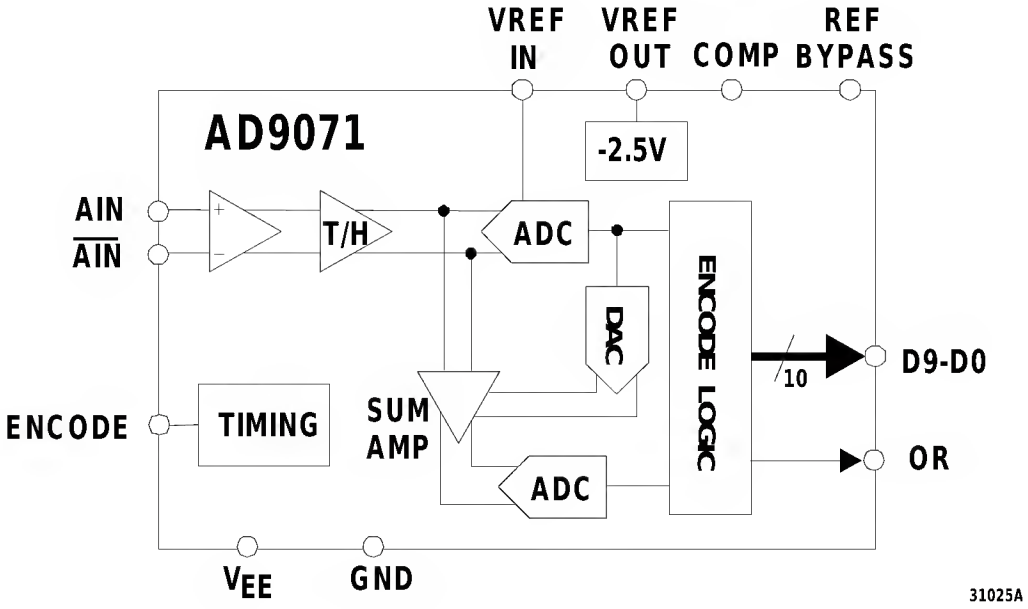
The ADC requires only a single –5V supply and an encode clock for full–performance operation. The digital outputs are TTL compatible. An Out–of–Range output (OR) indicates that a conversion result is outside the operating range. The output data are held at saturation levels during an out–of–range condition.

The input amplifier supports single–ended interfaces. An internal +2.5V reference is included in the SOIC–packaged device (an external voltage reference is required for the DIP version).

Fabricated on an advanced BiCMOS process, the AD9071 is available in a plastic SOIC package specified over the industrial temperature range (–40°C to +85°C).

FEATURES
10–Bit, 100Msps ADC
Low Power: 600 mW at 100 Msps
On–Chip Track/Hold
230 MHz Analog Bandwidth
SINAD = 54dB @ 41MHz
On–Chip Reference
1Vp–p Analog Input Range
Single +5V Supply Operation

APPLICATIONS
Digital Communications
Signal Intelligence
Digital Oscilloscopes
Spectrum Analyzers
Medical Imaging
Radar
HDTV



REV. 1

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AD9071—SPECIFICATIONS

ELECTRICAL CHARACTERISTICS (V_{CC} = 5V, ENCODE = 100 Msps)

Parameter	Temp	Test Level	AD9071BR Min	Typical	Max	Units
RESOLUTION				10		bits
DC ACCURACY						
Differential Nonlinearity	+25°C	I		±0.6	+1.25/–1.0	LSB
	Full	VI		±0.7	+1.5/-1.0	LSB
Integral Nonlinearity	+25°C	I		±0.6	±1.5	LSB
	Full	VI		±0.9		LSB
No Missing Codes	Full	VI		Guaranteed		
Gain Error [1]	+25°C	I		±1	±4	% FS
	Full	VI				% FS
Gain Tempco[1]	Full	V		115		ppm/°C
ANALOG INPUT						
Input Voltage Range (with respect to AIN\)	Full	V		±512		mV p–p
Common Mode Voltage	Full	V		2.5±0.2		V
Input Offset Voltage	+25°C	I		±7	±18	mV
	Full	I		±8		mV
Input Resistance	+25°C	I	10	40		kΩ
	Full	I		40		kΩ
Input Capacitance	+25°C	V		3		pF
Input Bias Current	+25°C	I		75	200	µA
	Full	I		75		µA
Analog Bandwidth, Full Power	+25°C	V		230		MHz
REFERENCE OUTPUT						
Output Voltage	Full	VI	2.4	2.5	2.6	V
Temperature Coefficient	Full	V		170		ppm/°C
SWITCHING PERFORMANCE						
Maximum Conversion Rate	Full	VI	100			Msps
Minimum Conversion Rate	Full	IV			40	Msps
Encode Pulse Width High (t_{EH})	+25°C	IV	4.5		13	ns
Encode Pulse Width Low (t_{EL})	+25°C	IV	4.5		13	ns
Aperture Delay (t_A)	+25°C	V		0.85		ns
Aperture Uncertainty (Jitter)	+25°C	V		2.5		ps rms
Output Valid Time (t_V) [2]	Full	VI	1.0	2.2		ns
Output Propagation Delay (t_{PD}) [2]	Full	VI		3.2	5.0	ns
Output Rise Time (t_R)	Full	VI		3		ns
Output Fall Time (t_F)	Full	VI		3		ns
DIGITAL INPUTS						
Logic "1" Voltage	Full	IV	2.0			V
Logic "0" Voltage	Full	IV			0.8	V
Logic "1" Current	Full	VI			±10	µA
Logic "0" Current	Full	VI			±10	µA
Input Capacitance	+25°C	V		3		pF
DIGITAL OUTPUTS						
Logic "1" Voltage	Full	VI	V_{CC}-0.1			V
Logic "0" Voltage	Full	VI			0.1	V
Output Coding				Offset Binary		
POWER SUPPLY						
V_{EE} Supply Current (V_{CC} = 5V)	Full	VI	80	120	150	mA
Power Dissipation[3]	Full	VI	400	600	750	mW
Power Supply Sensitivity[4]	+25°C	I		0.005	0.012	V/V

Parameter	Temp	Test Level	AD9071BR Min	Typical	Max	Units
DYNAMIC PERFORMANCE [5]						
Transient Response	+25°C	V		3		ns
Overvoltage Recovery Time	+25°C	V		4		ns
Signal–to–Noise Ratio (SNR)						
(Without Harmonics)						
f_{IN} = 10.3 MHz	+25°C	I	55	57		dB
	Full	V		56		dB
f_{IN} = 41 MHz	+25°C	I	54	56		dB
	Full	V		55		dB
Signal–to–Noise Ratio (SINAD)						
(With Harmonics)						
f_{IN} = 10.3 MHz	+25°C	I	54	56		dB
	Full	V		55		dB
f_{IN} = 41 MHz	+25°C	I	51	54		dB
	Full	V		53		dB
Effective Number of Bits						
f_{IN} = 10.3 MHz	+25°C	I	8.8	9.2		bits
f_{IN} = 41 MHz	+25°C	I	8.5	8.9		bits
2nd Harmonic Distortion						
f_{IN} = 10.3 MHz	+25°C	I	63	70		dBc
f_{IN} = 41 MHz	+25°C	I	58	63		dBc
3rd Harmonic Distortion						
f_{IN} = 10.3 MHz	+25°C	I	65	71		dBc
f_{IN} = 41 MHz	+25°C	I	57	61		dBc
Two–Tone Intermod Distortion (IMD)						
f_{IN} = 10.3 MHz	+25°C	V		70		dBc
f_{IN} = 41 MHz	+25°C	V		60		dBc

NOTES

1. Gain error and gain temperature coefficient are based on the ADC only (with a fixed 2.5V external reference).
2. t_V and t_{PD} are measured from the threshold crossing of the ENCODE input to the 50% levels of the digital outputs. The output ac load during test is 10pF.
3. Power dissipation is measured under the following conditions: § 100 Msps, analog input is –1 dBfs at 10.3 MHz. Power dissipation does not include the current of the external ECL pulldown resistors that set the current in the ECL output followers.
4. A change in input offset voltage with respect to a change in V_{cc}.
5. SNR / harmonics based on an analog input voltage of –1.0 dBfs referenced to a 1.024V full–scale input range.
6. Typical thermal impedance for the R style (SOIC) 28–pin package: Θ_{JC} = 23°C/W, Θ_{CA} = 48°C/W, Θ_{JA} = 71°C/W.

ORDERING GUIDE

Model	Temperature Range	Package Option
AD9071BR	–40°C to +85°C	R–28
AD9071/PCB	+25°C	Evaluation Board

EXPLANATION OF TEST LEVELS

Test Level

I 100% production tested.

II 100% production tested at +25°C and sample tested at specified temperatures.

III Sample tested only.

IV Parameter is guaranteed by design and characterization testing.

V Parameter is a typical value only.

VI 100% production tested at +25°C; guaranteed by design and characterization testing for industrial temperature range.

ABSOLUTE MAXIMUM RATINGS *

V_{CC} ..... 6 V
Analog Inputs ..... V_{CC} +1V to -1.0 V
Digital Inputs ..... V_{CC} to 0.0 V
VREF IN, VREF OUT ..... V_{CC} to 0.0 V
Digital Output Current ..... 10 mA
Operating Temperature ..... –55°C to +125°C
Storage Temperature ..... –65°C to +150°C
Maximum Junction Temperature ..... +175°C
Maximum Case Temperature ..... +150°C

* Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions outside of those indicated in the operation sections of this specification is not implied. Exposure to absolute maximum ratings for extended periods may affect device reliability.

PIN DESCRIPTIONS

Pin Number AD9071BR	Name	Function
1, 7, 12, 21, 23	GND	Ground
2, 8, 11	V_{CC}	Analog Power Supply. Nominally 5.0V
20, 22	V_{DD}	Digital Power Supply. Nominally 5.0V
3	VREF OUT	Internal Reference Output (2.5V typical); Bypass with 0.1µF to V_{CC}
4	VREF IN	Reference Input for ADC (2.5V typical)
5	COMP	Internal Amplifier Compensation. 0.1µF GND
6	REF BYPASS	Reference Bypass Node. 0.1µF to GND
9	AIN\	Analog Input – Complement
10	AIN	Analog Input – True
13	ENCODE	Encode Clock for ADC (ADC Samples on Rising Edge of ENCODE)
15-19, 24-28	D9–D0	Digital outputs of ADC. D9 is the MSB. Data is offset binary
14	OR	Out of Range output. Goes HIGH when the converted sample is more positive than 3FFh or more negative than 000h (offset binary coding)

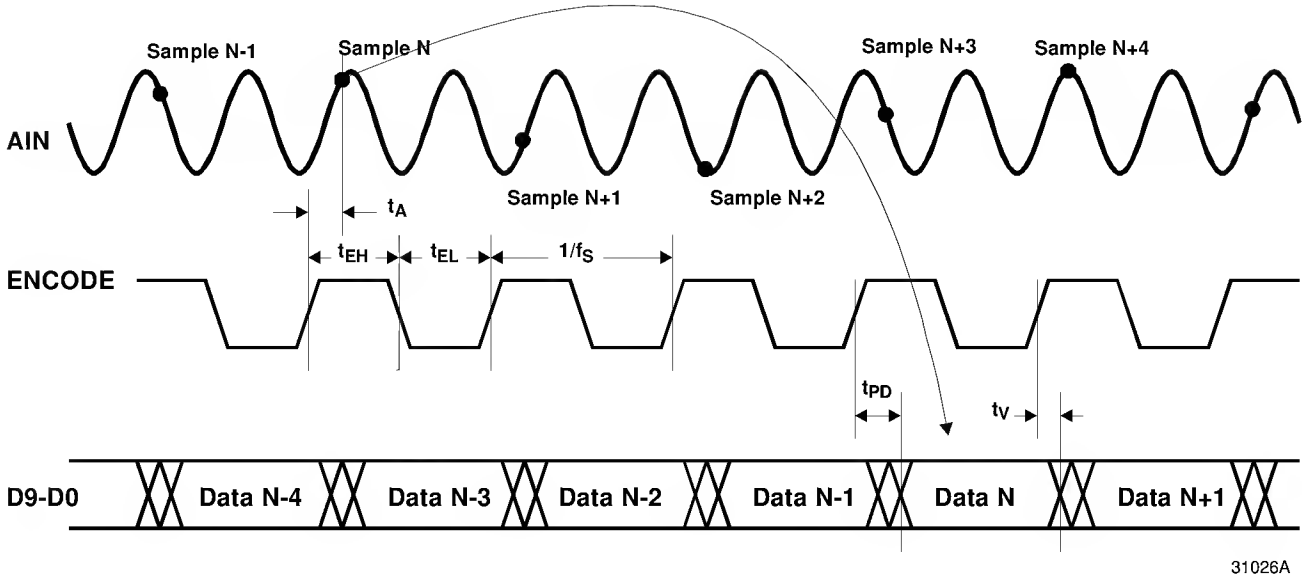

Figure 1. Timing

Step	$A_{IN} - A_{IN}$\	Code	Offset Binary	OR
1024	≥ 0.512 V	>511	11 1111 1111	1
1023	0.511 V	511	11 1111 1111	0
1022	0.510 V	510	11 1111 1110	0
•	•	•	•	•
•	•	•	•	•
•	•	•	•	•
513	0.001 V	1	10 0000 0001	0
512	0.000 V	0	10 0000 0000	0
511	–0.001 V	–1	01 1111 1111	0
•	•	•	•	•
•	•	•	•	•
•	•	•	•	•
1	–0.511 V	–511	00 0000 0001	0
0	–0.512 V	–512	00 0000 0000	0
–1	≤ –0.513 V	<512	00 0000 0000	1

Table 1. Output Coding